Explaining international R&D alliances and the role of governments

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R. Narula[1] and J.H. Dunning[2]

ABSTRACT: Globalisation, alliance capitalism and R&D intensive value adding activities are hallmarks of economic activity in advanced industrial countries. National governments have responded to these changes by pursuing policies promoting "techno-nationalism" which includes fostering R&D investment by national champions. First, we wish to enquire, from the firm's perspective, why they have an increasing propensity to undertake R&D alliances, with particular focus on international alliances. Second, we try and understand the role of governments in promoting and engaging in the generation and diffusion of intellectual capital in general, and in facilitating inter-firm technological alliances in particular. Third, we wish to evaluate the efficacy of techno-nationalism, in light of the welfare and social responsibilities of governments, particularly in an age of globalisation. We suggest that the role of government is best restricted to L-advantage augmentation, basic research investment and improving international coordination of technology markets.

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INTRODUCTION

One of the distinctive features of the process of globalisation has been the growth of cross-border value added activities by firms, and the subsequent increasing interdependence of economies. However, the growth of globalisation has led to a chain reaction, in that there has been an increasing trend for the activities of firms - both domestically and internationally- to be undertaken not just through internalisation of intermediate product markets by hierarchies (referred to as 'hierarchical capitalism'), but through what has been coined 'alliance capitalism' (Gerlach 1992, Dunning 1995a, 1997).

Specifically, alliance capitalism as used here, refers to the growing use of non-market, quasi-hierarchical modes of corporate activity, whereby firms do not completely (or formally) internalise their value added activities, but utilise a variety of cooperative and collaborative associations with other firms to achieve the same goals but especially those to do with augmenting their own competitive advantage (Dunning 1995a).

It has been noted that while alliance capitalism is an endemic phenomenon, its application is most pervasive by firms from advanced industrialised countries, and to a lesser extent, among those fast growing newly industrialising NICs (Hagedoorn and Narula 1997). Indeed, as has been noted by us elsewhere (Dunning and Narula 1994, 1995), the emergence of alliance capitalism as a socio-economic phenomena is a characteristic of the fifth stage of the investment development path.

As has been emphasised elsewhere, the economies of the industrialised countries are generally based on value added activity that are capital and knowledge (i.e., created asset) -intensive, and the generation and maintenance of these assets is crucial in determining the competitiveness of firms from these countries as well as the competitiveness of these countries as locations for economic activity. As national governments are frequently involved in promoting the human and physical resource competitiveness within their jurisdiction, they are, *pari passu*, also involved, directly or indirectly, in their creation or utilisation[3]. One of the critical aspects of created assets concerns the generation and subsequent diffusion of intellectual capital[4] particularly that arising from investment in research and development (R&D) activities and human resource development. However, the nature of knowledge capital and the problems of fully appropriating its benefits has two aspects to it. First, it is partly of a public good nature, but at the same time, in high technology sectors, it is also highly tacit and context-specific in nature as such, due to its inherent uncertainty, there tends to be sub-optimal R&D investment (including training programs) by firms. As such, one of the primary roles of governments is acknowledged as reducing the risks and costs and increasing the social benefits of the generation and diffusion of intellectual capital. However, although most national governments agree on the need to intervene to improve

[3] For instance, by being involved in the generation and diffusion of knowledge, both in the sense of technology and acquiring access to foreign markets.

[4] Intellectual capital is a generic term which includes knowledge, information and experience embodied in both human and physical resources.

and sustain created assets, not all agree on the most optimal method to do so[5]. In particular, there has been an increasing tendency among a number of industrialised country governments towards direct intervention favouring domestic firms, in what has been described as "techno-nationalism" (Ostry and Nelson 1995). we delve into understanding the logic of techno-nationalism in this age of alliance capitalism.

. The purpose of this paper is thus threefold. First, we wish to enquire, form the firm's perspective, why they have an increasing propensity to undertake R&D alliances, with particular focus on international alliances. Second, we try and understand the role of governments in promoting and engaging in generation and diffusion of intellectual capital in general, and in facilitating inter-firm technological alliances in particular. Third, we wish to evaluate the efficacy of techno-nationalism, in light of the welfare and social responsibilities of governments are, particularly in an age of globalisation. The remainder of this paper is organised as follows. Section 2 will discuss the growth of alliance capitalism. Section 3 will concentrate on understanding the growth of R&D alliances by firms, and the theorise on its nature. Section 4 will specifically address the development of cross-border alliance activity. Section 5 presents arguments of why governments are interested in the R&D activities of firms, while section 6 discusses the interaction between governments and international R&D alliances. Section 7 will evaluate the various means (both direct and indirect) by which governments are involved in strategic alliance activity. Section 8 will present the conclusions of the paper and discuss some policy implications.

2. ALLIANCE CAPITALISM

Although the use of cooperative and collaborative as a means of protecting or advancing the competitiveness of the participating firms is not new, the propensity of firms to engage in such activities has increased dramatically in recent years. Since the beginning of the 1980s, there has been a virtual explosion of strategic alliance formation, with the number of agreements having increased at an average rate of 9.8% annually between 1980 and 1994 (Hagedoorn and Narula 1997). This has prompted suggestions that economic activity through inter-firm alliances is no longer an inferior option to the use of hierarchies, and that in many cases is regarded as the first-best option (Ciborra 1991). It has been suggested elsewhere (Dunning 1995a, 1997) that this represents a shift in the paradigm of market-based capitalism, in which economies are moving away from hierarchical capitalism towards alliance capitalism. Moreover, where firms do engage in hierarchies, it is increasingly through the use of mergers and acquisition (M&A), which like strategic alliances are undertaken not so much as a means of reducing transaction costs but as a means of protecting and augmenting the competitiveness of the participating firms, and can also be regarded as an extreme form of collaboration. Indeed, there is a strong link between M&A and strategic alliances, in that firms, oftentimes, establish a strategic alliance with a prospective M&A target[6].

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[5] It should be noted that a distinction needs to be made regarding the difference between three elements of R&D: basic research, applied research and development There is relatively little controversy regarding the role of government in basic R&D. Fundamentally, our discussion centres around the extent and nature of government involvement in applied research and development activities.

[6] Although Hagedoorn and Sadowski (1996) indicate that only about about 2.6% of strategic alliances lead to M&A, this number is quite significant given that they are primarily focusing on alliances whose primary purpose is strategic technology partnering.

There are five inter-related phenomena at work here. First, there has been an increase in such activity across all of the advanced industrialised economies, as opposed to being a phenomenon peculiar to certain economies, such as Japan. Second, there is an increasingly strategic aspect to this activity, as alliances are no longer simply undertaken as a means of avoiding transaction and coordination costs of markets (a second-best, 'exit' response), but rather as a first-best 'voice' strategy to reduce market failure due *inter alia*, to barriers to entry[7], where this was thought preferable to the complete internalisation of these markets, where complete internalisation was not possible. Third, one of the original motives for alliance formation was to acquire market access and/or overcome supply bottlenecks, i.e., to achieve vertical integration where such integration was not possible through hierarchies. Firms engaged in very little alliance formation on a horizontal basis as they do today. Fourth, inter-firm alliances are increasingly being undertaken, through various modes, as a direct response to pressures brought about contemporary technological developments and globalisation. Fifth, whereas alliances were primarily undertaken for the purpose of achieving or improving market entry and presence, an increasing number of alliances are being undertaken to protect or enhance the created assets of the participating firms.

The advent of alliance capitalism is in fact in keeping with what the theory might predict, and is associated with stage 5 of the investment development path[8] (IDP) (Narula 1995, Dunning and Narula 1994, 1996), which is especially applicable to the advanced industrial countries. As countries enter the fifth stage of the IDP, there is a tendency for the outward and inward direct investment position to balance, and to fluctuate around this position over time. In this stage, firms from these countries are increasingly involved in intra-industry and intra-firm trade and investment, as they restructure their activities on a global or regional basis. At the same time, the ownership and territorial boundaries of firms become obscured they increasingly engage in trans-border cooperative agreements. This is as a result of increasing competition across borders between multinational enterprises (MNEs), and the tendency for the competitive advantages of both countries and firms to be in sectors which are based of created assets and technologies that are highly tacit in nature. Indeed, the concept of globalisation is very much a reflection of the changes associated with Stage 5 of the IDP.

Globalisation as used in this paper signifies the growing convergence of income levels and consumption patterns between industrialised and several industrialising countries, and the deepening economic interdependence between these countries (Dunning and Narula 1997). The three main forms of this interdependence are foreign direct investment (FDI), cross-border alliances and networks, and intra-firm and intra-industry trade resulting from the growth of FDI and alliance activity. These have resulted in global supply and demand pressures that have affected the competitiveness of firms as firms increasingly compete not just with firms in the home country, but also with those firms in the same industry in different countries. It is not our intention to review the contributing factors to globalisation, and we summarise these in figure 1.

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[7] For a discussion of exit and voice strategies of firms to markets, see Dunning (1995a).

[8] The IDP suggests that the international direct investment position of a country (i.e., the outward less the inward direct investment) goes through various stages according to its economic development (measured both by its GNP per capita and changes in the structure of its economic activity). For further details see Narula (1995) and Dunning and Narula (eds.) (1996)

3. THE GROWTH OF R&D ALLIANCES: ACQUIRING TECHNOLOGICAL COMPETENCE.

In this paper we shall concentrate on just one of the responses of the events described in the previous section, viz., the growth of strategic technology partnering (STP) between firms. As we have discussed in the previous section, the growth of strategic alliance activity mirrors the changes taking place across countries and sectors towards a convergence of technologies, supply and demand conditions, which is simplistically referred to as globalisation. However, despite these macro-level phenomenon, it is important to understand firm-specific explanations the growth of strategic alliances in general, and STP in particular. This distinction is important, since STP represents a especial case of alliances, given the unique nature of innovating and creating especially through R&D activities.

First, R&D differs from other forms of value adding activity. R&D activities represent the process of knowledge creation and development, either in a formalised process, or through incremental learning through informal means; and to the development and/or enhancement of the ownership specific (O) advantages of

firms. All other value adding activities of firms represent the utilisation of these O advantages. Indeed, R&D activities are undertaken at the various stages of the value added chain, and are essential for the continued existence of the firm. All O advantages are generated in a similar way, regardless whether through formal R&D, or through other informal means. knowledge is generated through routines, since the firms is boundedly rational and path-dependent. In other words. firms engage in 'localised searches' which are directly related to their current activities. As a result of this, technology is to a great extent both firm- and context-specific (Nelson and Winter 1982). This has always been regarded as one of the main reasons why firms will prefer to exploit these O advantages through hierarchies and remain centralised in their home country, because these advantages may not be fully appropriable either by another firm or at a different location, (or both), without considerable additional costs.. Furthermore, even where another firm is able to do so efficiently, the public good nature of technology will mean that the innovating form will not receive compensation for its R&D output commensurate to its value. This tendency would be greater the higher the tacit and non-codifiable aspect of the technology.

In addition, the benefits of innovations are only partly appropriable through markets given the public good nature of technology[9]. The seller cannot get a buyer for his innovation without revealing it, and thus losing some of its value. On the other hand, the buyer cannot make a rational decision regarding the value of the innovation, without full disclosure, thus making a sub-optimal offer for it. Thus this implies that the innovator can only generate maximum rents from the technology through internalising its use, since they alone are aware of its actual value.

In summary, since the level of tacitness of knowledge generated through routines is higher, it is logical to expect that newly generated O advantages are more firm- and context-specific than current O advantages of the firm. It may then be reasonably argued that firms, *ceteris paribus*, will have a higher propensity to internalise the market for R&D related output than for intermediate products generated through production activities at other parts of the value added chain. Likewise, it can be argued that firms will prefer to centralise their R&D activities to a greater extent than production.

The evidence on internalisation of R&D activities, however, remains ambivalent - not only are firms engaging in a growing number of STP agreements that explicitly involve joint technology development, but a large percentage of these are in knowledge-intensive sectors (Hagedoorn and Narula 1996). Furthermore, it would also be reasonable to expect that in the event that full internalisation were impossible for whatever reason, firms might prefer to use organisational modes that provided the maximum amount of control over the innovatory process. This, however, does not appear to be the case - recent evidence indicates that there is an increasing propensity to utilise non-equity type of agreements, and this trend cuts across sectors and countries (Narula 1997).

Although recent evidence on decision taking locus by firms continues to indicate a preference for centralisation of formalised R&D activities (see for instance, Patel, 1996 Dunning and Narula, 1995). Moreover, the extent of internationalisation of R&D of firms continues to be considerably less than that of

[9] It should be noted that, throughout the remainder of this paper, our arguments apply to the more formalised process of R&D rather than the informal processes of R&D.

production, there has nonetheless been a distinct shift towards internationalisation of R&D activities, one reason for which has been the sharp growth of strategic asset-seeking FDI activity (Dunning and Narula 1994, 1995).

In other words, the economic imperative to internalise the markets for knowledge based activities and to locate these activities in the home country of the innovating firm is being challenged by changes in the way firms view the global market place. What we are trying to emphasise here is that the forces underlying globalisation have considerably influenced the way in which firms locate their R&D activities and the organisational modes used. There have been several attempts to develop a taxonomy of reasons why firms are gradually challenging the conventional wisdom about the modality and geography of R&D activities, and these are summarised in Figure 1.

4. WHY ALLIANCES OCCUR ACROSS BORDERS[10]

The above paragraphs do not explicitly direct their attention to international alliance formation, i.e., what are the additional factors to be taken into account in cross-border activity. The transaction costs approach has been extensively studied (e.g., Kogut (1988), and Hennart (1993) among others) and suggests that pure hierarchies are sometimes a more costly strategy than through alliances, due to the associated higher financial risks and barriers to entry. However, there is another aspect to this from FDI theory. The eclectic paradigm (e.g., Dunning 1993) suggests firms engage in foreign based value added activity if they possess O advantages that they wish to utilise in conjunction with the location advantages of the host region or country. In the case of technology development, however, these advantages are often of a non-codifiable nature and, given the firm-specific nature of such assets, it may be that the location advantages cannot be completely captured by the foreign investor because they are specific to domestic firms rather than the country they are located in. Therefore, firms are obliged to engage in STP rather than subsidiary (i.e., majority-owned) FDI activity.

This particular point has been developed by one of the current authors in another paper (Dunning 1995a). In short, firms from one country with O advantages may seek to utilise them in a foreign country either in conjunction with immobile but generally available assets of the host region, or with the ownership advantages of firms in that location, when advantages it seeks are firm specific. Such a firm may be a competitor, supplier or customer to the foreign firm.

However, it is pertinent to point out that what we have described here could very well also apply to a network, or other transaction cost economising agreement The difference between a cost-economising agreement and a strategic alliance is the presence of a "strategic" element, which, is described as "an agreement which affects the long term product-marketing positioning of the firm" (Hagedoorn and Narula 1996), or , in other words, does not simply minimise the net costs, but also improves the future value of the firm[11] Focusing our sights once again on the special case of the strategic technology partnering agreement, 'strategic' implies the transfer of some extent of knowledge, on at least a unilateral basis, by at least one of the partners as part of the agreement. In other words, an R&D alliance may be undertaken in a location with a

[10] See Osborn and Hagedoorn (1997) for a review of the literature.

[11] The important considerations between the transaction cost school (which emphasises cost) and the organisational capability school (which emphasises value) is succinctly summarised in Madhok (1997).

complete absence of 'traditional' location advantages, when the objective is primarily to acquire firm-specific O advantages through the process of partnering. While the presence of this firm may signify a concentration or agglomeration of firms in a given location (an L advantage), this is not necessarily always the case. That is, while L advantages may have determined the nature of the O advantages of the domestic firms, their transfer to a foreign partner within the framework of an alliance constitutes the utilisation of the domestic partner's O advantages, and not the L advantages from which they may have originally derived. It is pertinent to note that STP does not necessarily imply that it is not simply technology that is being shared or created, but generally also includes a market-related knowledge, be it intra-firm, intra-industry or country-specific. That is, STP may also include the transfer of knowledge which is normally associated with transaction cost-minimising activity, that are referred to as Ot advantages in the FDI literature.

Nonetheless, there is a caveat to be noted here, as the preceding discussion might suggest that both partners should not have a particular preference for the location at which their partnership might be consummated. As we have earlier explained, the knowledge base of any given firm is context-specific, since the O advantages, being path-dependent, are a direct result of the comparative and competitive advantage of the home location (Cantwell 1989, Archibuigi and Pianta 1992, Narula 1995). As such, where the foreign partner wishes to internalise these O advantages through STP, it can more efficiently do so in the location where they were generated. This is equally valid for market-oriented STP and R&D oriented STP.

So far we have sought to explain why firms prefer to engage in non-market mechanisms to develop technology, because of the nature of technology creation vis-a-vis technology exploitation. This is in line with the results of several studies (e.g., Pearce and Singh 1992, Patel and Pavitt 1992, Dunning and Narula 1995) that have demonstrated that MNEs prefer to conduct much of their R&D activities in their home country. At the same time, there are suggestions that firms are developing multiple home bases for these activities and engaging in foreign based R&D activities to augment as well as to exploit their competitive advantages (Keummerle 1996). It is therefore logical to expect that where the firm finds it necessary to engage in alliances to develop technology (R&D), (rather than gaining market knowledge), they will prefer to engage in alliances with 'local' partners given the costs of adapting the context-specific nature of their ownership advantages. Duysters (1995) demonstrates that R&D-related STP tends to be less international than market-oriented STP.

5. THE ROLE OF GOVERNMENTS: A WELFARE PERSPECTIVE

It should by now be patently obvious that national governments have a strong interest in the ability of firms in a given location to conduct competitiveness-enhancing activities, and particularly those associated with the creation and deployment of knowledge capital. These reasons can be qualified under two main headings, viz., the promotion of wealth creating assets of its firms (O advantages), and maintaining and improving indigenous resources and capabilities (L advantages). By doing so, it can help maintain and improve its own locational attractiveness to mobile and footloose investors (of whatever nationality) to conduct high value adding activity. These two issue are strongly related, since the presence of highly competitive firms at a given location acts as an L advantage, often prompting a virtuous circle. Conversely, strong L advantages,

such as the presence of support institutions and firms, infrastructure and skilled manpower (i.e., the national systems of innovation) will enhance the O advantages of firms located there.

In other words, the reduction of market imperfections in the creation and utilisation of knowledge capital has considerable welfare benefits, which stem both from a direct result of these activities, and from externalities generated by them. It is also to be noted that governments may intervene for at least three other reasons which are only indirectly related to advancing competitiveness. Among these we might mention first to protect or advance economic or political sovereignty. The second is for strategic reasons, such as in defence-related issues. The third is, where investment in R&D is primarily undertaken to promote social goals, such as in the health and environment sectors. It is to be noted that in both of these cases, even though R&D may be undertaken by private firms for commercial application elsewhere, the interest of government is to limit diffusion (e.g., in the defence sector) of the technology to non-national firms, or to maximise diffusion (such as the health and environment sectors) of innovations, by, for example, acquiring the property rights and providing it at marginal cost to all firms. However, in our current exposition we are interested in the role of governments in affecting commercial R&D activity, and as such we shall not explore other issues in greater detail. We identify three main reasons that governments have an interest in fostering R&D activities.

A. First, there is the question of <u>level of investment</u> in R&D. Countries with low expenditures in R&D tend not to be as competitive (e.g., Archibuigi and Pianta 1992). As such governments have an incentive to encourage R&D activities. Without government intervention, firms may tend to under-invest given their bounded rationality and the path dependent nature of their activities. Since firms prefer to engage in new activities closely linked to their current activities, and may result in too little R&D investment, *relative* to other kinds of investment (Hall 1986). Further, greater uncertainty may arise from competition: another firm may be doing similar research. Neither the time that the research will be completed nor the identity of the winner of the race to innovate, is known. The risk from these and other problems is often reflected in the cost of capital to the firm intent on undertaking R&D, and the higher the risk, the more difficult it may be to acquire capital to undertake it. In the limit, financial capital may be unavailable for risky research projects. On the other hand, it is possible that too many, rather than too few, resources may be applied to R&D (Barzel 1968). This might occur for example where several firms are in a 'race' to solve a given technological problem, and this may lead to over investment in R&D. In other words, there is the (1) danger of firms investing in under-investing in new technologies with which they are unfamiliar, or are too risky; (2) the risk of over investment in a given project due to duplication of investment by several firms.

<u>B. Problems from appropriability</u> Society is faced with the difficulty of sustaining economic growth through encouraging innovative activity by providing monopoly power to the inventor so that he may continue to innovate at a socially optimal level on the one hand, but on the other, to maximise diffusion and availability of products at the lowest possible costs, generally by encouraging competition. However, firms will under-invest in R&D when they are uncertain of appropriating sufficient returns. This occurs because of three reasons. First, because the value of an innovation is not always apparent to the market *ex ante*. Second, even where the value of the innovation is known to the inventor, it cannot convince others without revealing the details of the innovation, thereby losing some its value because of its public good nature. Third, even where the

firm overcomes these two hurdles, it cannot charge the market the actual value of the innovation, but the opportunity cost, or the value of the next best option available on the market (Barzel 1968). As such, it will remain uncertain as to whether it can recuperate the costs of its investment, unless the government is able to act as a broker in this process. The traditional route by governments is to administer and issue patents, but these are highly imperfect tools to assign property rights, and are also inefficient. It is to be stressed that while government intervention is a possible solution it is not the *only* solution, and indeed, there are several instances and situations where the market is able to partially rectify itself. Firms that are unable to patent utilise secrecy and lead times as methods to protect their property rights (Levin et al 1987), but are also unlikely to spread the risks and costs of R&D among the potential users of the innovation.

C. Industry structure and concentration. The third concern is the prevention of oligoplistic and/or monopolistic behaviour in asset creation and utilisation. It is axiomatic that demand is necessary as a catalyst to innovation, and the competition to survive among firms in a given industry drives the generation and diffusion of technology. However, it remains unclear what the optimal level of competition is. Dasgupta and Stiglitz (1980) among others have shown that there is a positive relationship between competition in R&D and the level of innovation, but it is as yet unclear what the appropriate level of innovatory activity is. On the one hand, there is evidence to indicate that when there are a larger number of firms engaged in R&D in a given industry, the average level of R&D investment per firm falls, but the total investment in the industry rises. On the other hand, there is also evidence that would conform to the Schumpeterian idea that innovative activity may be encouraged by industry structures in which firms are few and concentration is substantial. This is a complex issue that remains unresolved, and is very much a question of country-specific policy. Certainly, it would appear that given the cost and risk of R&D in the age of globalisation, a few large firms are more likely to be successful than a large number of small ones. How the implementation of R&D alliances affects the optimum industry structure is unclear, but in general, governments have preferred to limit strategic alliances of firms in a given industry to pre-competitive research (e.g., SEMATECH, ESPIRIT).

6. GOVERNMENTS AND INTERNATIONAL R&D ALLIANCES

The discussion thus far illustrates the importance attached by national governments to the creation and diffusion of knowledge capital, which is regarded as the bedrock upon which the economic prosperity (i.e., the competitiveness) of the advanced industrial countries is built. However, the influence of governments on the competitiveness of their economies has been somewhat diluted with the advent of globalisation, and in its wake, alliance capitalism. Globalisation, as discussed here has meant, *inter alia*, (1) an increasing interdependence and convergence in consumption patterns and technologies across countries; (2) the increasing internationalisation of production through networks of MNE affiliates, (3) increasing overlapping and merging of industrial sectors, increasing capital and knowledge intensity as well as a concurrent shortening of technology life cycles (figure 1). To take a couple of examples. Governments find it much more difficult to enforce the appropriability of technology when intellectual property rights are violated in countries where such protection is limited, thereby perhaps raising the cost of products to domestic consumers, and further affecting the willingness of these firms to invest in R&D. likewise, there is increasing difficulty in

identifying and determining where R&D investment is made, and who reaps the benefits therefrom, especially here the innovation is done in, say, Phillips' R&D facility in the US, or, even more complex, when the innovation is from the UK lab of Anglo-Dutch conglomerate, Unilever. Ostry and Nelson (1995) suggest that because of the difficulties of enforcing and monitoring international compliance to property rights as well as the declining efficacy of patents, government support of R&D is the best way to induce industrial innovation, rather than relying on the market to provide an adequate return.

This line of reasoning has a considerable following, not least among economists who advocate 'strategic trade theory', as well as most neo-Schumpeterian economists. Essentially the argument made is that since technology defines competitiveness, and with the cost of R&D activity rising, an oligoplistic market structure would be optimal. A small number of firms would reap higher profits, which would support higher wages. However, since every country would like its firms (or one of them) in each high-tech, capital intensive sector to be among the surviving firms, this has led to a sort of "techno-nationalism" where every country supports its national champions through various means in the bid to maintain its technological competitiveness.

However, this techno-nationalism has resulted in a sort of prisoners dilemma, as globalisation makes it much more difficult to identify what constitutes a national champion, as has proven to be the case with ICI or Rover. Indeed, Ostry and Nelson (1995) argue that policies that have sought to create national champions has actually furthered the process of transnationalisation, since barriers to imports has encouraged foreign MNEs to establish local value adding activities, and undertake alliances in order to receive national treatment.

It should be noted that it is by no means necessary that national governments regard STP as a first-best option, or even a second best one: it is debatable, for example, whether alliances whether R&D investment through alliances is quite at the same level as that achieved through internalised R&D activity by national firms. Certainly, it would seems obvious that government financial support to a collaboration between a national champion with a firm of another nationality may represent a subsidy to the foreign firm. Likewise, although a firm may see R&D subsidies provided to it by the government as a substitute for its own R&D efforts rather than an additional source of investment, leading to a net reduction in R&D expenditures on an national level. However, the question is not whether R&D investment through STP is a better solution than R&D investment by domestic firms, but whether it represents a better solution than that offered by the free market, and there is good reason to suspect that the market will be unable to achieve a welfare optimum[12]. Moreover, it is important to realise that it is not simply a question of maintaining the level of R&D investment, but also the efficiency of this investment.

Our discussion heretofore underlines the unresolved question of the prudence of government intervention in R&D activity. With R&D activity highly uncertain in nature, especially when such R&D activity is close to or at the technology frontier, and where the R&D is basic and conceptual in nature, the efficacy of government intervention is unclear. This is for two reasons. First, governments need to target

[12]The argument against intervention suggests that governments may not be able to do better than markets, and that since innovation occurs in response to market demand, it cannot be seriously sub-optimal. This line of reasoning is succinctly summarised in Hall (1986), pp 9-14.

industries and sectors which offer promise in the medium and long term, and are not sun-set industries. Besides there my be several different, competing technologies, but only limited funds. In such cases, choices have to be made, and firms do not have an incentive to reveal their true opinions, especially where the most 'deserving' firm is a rival one. As Farrell (1987) has emphasised, a central authority is bound to have less complete information than the firms in an given sector. When firms are engaged in R&D some distance away from the technological frontier, the direction in which investment is to be made is obvious since firms at the frontier (i.e., the technology leaders) have already done so[13]. The astounding success of MITI in picking winners in the 1950s and 1960s,and their less successful interventions in the 1980s and 1990s illustrates this point well. However, non-intervention is not the answer either, since firms that are risk averse will avoid investments in highly risky, economically less viable, 'blue sky' projects.

Secondly, where a 'worthy' project is defined, there are clear difficulties in identifying whether the government subsidies are being utilised for the purpose for which they were provided, or simply a mechanism for cross-subsidisation of other R&D projects. This arises from the tacit nature of basic R&D in high technology industries, since the output may not be patentable or have a an identifiable, tangible form.

It is not our aim here to evaluate the wisdom of government involvement in promoting R&D activity, or to criticise techno-nationalism[14]. Our position is based on the assumption that these are the implicit goals of national governments of the advanced industrial countries (for a review, see Ostry and Nelson, 1995). However, the evidence reviewed so far indicates that firms must necessarily engage in asset-exploitation on a global (or at least regional) basis if they are to remain competitive, and albeit to a lesser degree (but to a growing extent), develop and acquire new assets globally. The evidence reviewed would also indicate that, in general, firms are more willing to engage in collaborative R&D activities in overseas locations than engaging in wholly owned R&D activities, and this has much to do with techno-globalism (Archibuigi and Michie, 1994).

Having said this, however, there is no consensus on the optimal way to boost the competitive advantage of firms through strategic alliances. On the one hand, countries such as the US have hitherto attempted to deal with the root causes of market failure by attempting to make markets more efficient, but only directly intervening on a reactive, case-by case basis (for instance, ins sectors which defence applications may exist) . Countries such as France and Japan, on the other hand, have taken a more active, or direct role[15].

7. OPPORTUNITIES FOR GOVERNMENTS: DIRECT VS INDIRECT INTERVENTION

We have thus far illustrated that insofar as governments are concerned, their primary interests lie in strengthening the competitiveness of its national firms. The evidence would suggest that the role of governments, at least in the case of the Stage 5 countries, is most effective as a facilitator of competitive

[13] It is necessary to emphasise the difference between firms that are a distance from the technology frontier, and those that are simply experiencing X-inefficiency. The latter group are simply using an inferior technology, while the former are operating at an earlier stage of the product life cycle.

[14] See Krugman (1994) for such a critique. For a counter-argument, see Dunning (1995b)

[15] For details, see contributions to Nelson (ed.) (1993).

advantage, in terms of providing the complementary assets needed by firms, rather as a direct intervention role. These assets are best described as the national systems of innovation (NSI), and are defined as the network of institutions in the public and private sector in a given country that support the generation and diffusion of innovations (Freeman 1987). In the parlance of the eclectic paradigm, the NSI represent the location bound resources and capabilities that sustain, complement and enhance the O advantages of firms. In other words, indirect intervention takes the form of improving the O advantages of firms by affecting the L advantages of the country. By direct intervention we refer to actions of governments that directly influence the O advantages of firms. It must be noted that few countries desist completely from direct intervention. By direct intervention we refer *inter alia*, to attempts by governments to enhance the O advantages of firms by fiat, through restrictions on domestic operations of foreign MNEs (e.g., US airline industry), through the provision of exclusive contracts to develop products for the use of governments (e.g., the French TGV, eurofighter project, space shuttle, etc), exclusive (or subsidised) access to public sector research facilities. We will briefly discuss the options available to governments in connection to encouraging R&D alliances under these two headings.

Direct intervention

1. As a participant - Governments can engage as direct participants in R&D alliances as a partner. This is especially common in basic research projects, as public research institutes and universities have the human and capital resources to undertake fundamental R&D, or what is referred to as pre-competitive research by the EU. This is one of the means used by the EU to improve the competitiveness of European firms - indeed, almost 60% of funding within the second and third framework programmes which covered the period 1987 and 1994 12 billion ECUs was directed towards universities and public institutes (Geuna 1996). An additional advantage of direct participation is that it is better able to monitor the utilisation of the resources and act as a honest broker, and prevent the misallocation of funds by commercial (and profit-oriented) partners. NTT, the Japanese telecommunications giant has played a similar role in enforcing the partnership agreements undertaken by firms in telecommunications and computers, by sponsoring complementary research to that of MITI, and allowing the consolidation of national champions in each of these industries (Levy and Samuels 1991)

2. By guaranteeing a market for the output of the alliance. This can be undertaken in at least three ways. First, by providing project-specific contracts to consortia of firms, as is the case with most EU aero-space projects, and US defence related projects. This substantially reduced the risk associated with R&D, and at the same time improves the appropriability of the innovation. Second, by directly affecting the returns to the innovator by creating a market for the product. For example, in the 1970s Japanese government established the Japan Robot Company which bought all the output from the robot manufacturers, and then leased the robots to the customers. Third, by establishing a particular technology standard, which may be proprietary to a particular firm, and requiring firms to adhere to them. This has the added advantage that it prevents duplication of investment in other, inferior, alternatives. This is achieved through establishing cross-licensing agreements. The most successful of these, the aircraft patent agreement among US firms which remained in force between 1917-1968, was established at the behest of the US government during the first world war in order to standardise the use of the ‘best-practice’ technology in airframes across the various manufacturers

(Bittlingmayer, 1988). The difficulty in so doing is that first, governments may not necessarily select *ex ante* what the most superior technology is, and second, it requires a suspension of anti-trust regulations in most cases. In fact, the aircraft patent agreement was eventually terminated by the US supreme court, when it was deemed as contrary to anti-trust regulations.

3. Providing market access in exchange for technology to a domestic firm. By excluding foreign firms by insisting that a foreign-based MNE have certain minimum local content, and thereby create linkages, or that it take a domestic partner in exchange for access to the domestic market. The case of both European and US Voluntary Export Restrictions with Japanese firms led to an increase in FDI (and alliance formation) during the 1980s. A similar approach was taken by Korea during the 1960s (Amsden 1989), where technology transfer was made a condition for market access.

4. By making participation in alliances a pre-condition for future government contracts. Both the direction of research and the availability of subsidies can be used as leverage to encourage firms to undertake collaborative research. This is the case with Japanese computer industry, in which major Japanese firms were asked to collaborate on joint R&D, with the understanding that it affected future subsides from MITI. Levy and Samuels (1991) note that when Matsushita left the computer industry in 1964, it was unable to enter MITI-sponsored computer alliances for two decades.

Indirect intervention

The literature is replete with policy prescriptions to improve the L advantages and the quality of location-bound resources, and there is no reason to revise this literature here. The enhancement and improvement of L advantages has receieved considerable attention in various guises: see Porter (1990), Dunning and Narula [eds] (1996), Lundvall, (1993), Nelson (1993) and Dunning (1994) among others, and is as such relatively uncontroversial: there is therefore no need to develop a exhaustive typology of options here. we shall, however, highlight two important issues regarding countries' indirect intervention.

First, although governments are unable to prevent alliances from being unstable, or indeed, from reducing the inherent risk of R&D activity - whether collaborative or otherwise - there is a role for governments in providing information to help identify synergies, complementarities and opportunities, since there are market imperfections in the market for partners. Governments can help diffuse the results of basic research output produced either by government research institutes or private establishments to interested parties by creating a sort of 'market place' where potential partners can meet and exchange information. This is undertaken on a regular basis through trade fairs, but also directly through government institutions (Niosi 1995). Even where governments do not own the technologies, they can play an important role in match-making firms.

Second, there is an important and growing role for governments in encouraging and monitoring cross--border R&D alliances, and reducing uncertainty attached with this. First, this can be done by the development of binding multilateral intellectual property rights protection through agencies such as the World Trade Organization thereby improving appropriability of innovation, both domestically and internationally. There is a very real danger of cross-border duplication of activity, especially in terms of multiple (and not necessarily compatible) standards which can be potentially sub-optimal in terms of expenditure on a global

basis. Recent initiatives by the G7 members to jointly subsidise space research is such an example. The failure to develop a common standard on HDTV has largely affected its successful commercial launch. However, inter-governmental initiatives are, in general, the exception rather than the rule.

Areas in which governments intervention is futile

Despite the best efforts of governments, there nonetheless remain considerable risks associated with success or failure of an alliance (see Inkpen and Beamish 1996). Even where complementarities exist, and potential partners identified, there are several hazards that exist. Das and Teng (1996) suggest that these can be viewed as being of two types. Relational risk occurs as a result of one or more of the partners in an alliance being unwilling to work towards the mutual interest of the partnership, thereby breaching the agreement. Such behaviour may be rational or irrational, and includes asymmetrical learning, or a lack or trust. There is limited scope for government intervention in such an instance, since we would have to assume perfect information *ex ante* of the failure of a partner to provide inputs in the prescribed manner. Given the nature of R&D alliances, such an assumption is clearly unrealistic, and in the case of basic R&D, the asymmetrical learning may not be evident in the short term. Nor, it must be said, does relationship risk arise only from the failure of partners to maintain the agreement, but also where they interpret the agreement literally. Lastly, relational risk may be unintentional, since partners may have different objectives and different. The second sort of risk, performance risk occurs when all partners have cooperated fully, but the partnership has nonetheless not achieved its objective, and represents the opposite problem. The role of government here is also limited, except where such alliances had received government subsidies, since the question is whether in fact the failure of the partnering was due to inefficient and/or inappropriate use of the funds, or that the research trajectory was 'too far' from commercialisation for any tangible output to be generated. Such questions have been raised about the ESPRIT program of the European commission (Mytelka 1991).

8. CONCLUSIONS

Globalisation has led to profound changes in which business activities are conducted, not least because of the growing use of networks and alliances by firms from the advanced industrial countries. This process, dubbed 'alliance capitalism', represents a new phase in the evolution of the market economies, and is associated with the fifth stage of the IDP.

There has also been a concurrent growth in the use of alliances to acquire and develop knowledge capital. The growth of strategic technology partnering is somewhat strange, in that firms have hitherto preferred to internalise their R&D activities. Further, they have tended to geographically concentrate these activities in their home base. We have attempted to provide an explanation for these new phenomena within existing paradigms of FDI activity and neo-Schumpeterian theory. Furthermore, we have tried to explain the welfare and social rationale for government involvement in promoting and partaking in R&D activities in general and alliances in particular, paying special attention to the evolution of international strategic technology partnering.

It would seem that countries are increasingly engaged in promoting the competitiveness of their domestic firms, in what can be loosely be described as 'techno-nationalism'(Ostry and Nelson 1995), with the intention of developing 'national champions'. Most of the major industrial economies practice some sort of

government intervention to boost the O advantages of their firms. While some governments do so through indirect means that improve the quality of location bound resources and capabilities to attract mobile O advantages of domestic and foreign owned firms, others attempt more direct intervention by directly participating in O advantage-generating activities.

Much of this intervention was originally a response to globalisation, with the desire of protecting weak domestic firms from international competition. Ironically, this has led to a greater use of alliance and network-forming activity. as such, this techno-nationalism is doomed to failure, as the question of "who is us" and 'who is them" makes such policies increasingly redundant. National champions are equally willing to act as free agents, and are in some instances receiving national treatment (and support) from several governments, both national and regional. The example of IBM being involved in several research consortia funded by the EU and the US governments best illustrates this point.

As for the underlying motive of improving levels of R&D activity, this too would seem to be in doubt. It should be noted that R&D alliances are even more footloose than traditional majority-owned production or R&D activities, nor, it must be stressed, do R&D alliances provide significant levels of spillovers to the host economies where they might be located. Funds invested in joint research by governments are notoriously hard to track down, in terms of their application, both in a geographic and a technical (i.e., project-specific) sense. Furthermore, firms are more interested in establishing themselves near centres of agglomeration, regardless of where these might be located. This indicates a very real danger of entering into an incentive war, with so many countries willing to subsidise R&D (Niosi 1995), and with so little obvious spillovers therefrom.

The advice to governments is to view strategic technology partnering as a complementary to domestic R&D, rather than as a substitute. Furthermore, a distinction needs to be made regarding the various aspects of R&D: basic research, applied research and development. There is relatively little controversy about basic research and the need for governments to subsidise them, although the ability of governments to pick who to subsidise is another matter. However, strategic technology partnering is also relatively uncontroversial in basic research. The debate primarily revolves around applied research and development. In a roundabout sense, Krugman (1994) is right, albeit for the wrong reasons - countries dont compete, companies do. It is not the role of governments to try and enhance the O advantages of its firms, to the exclusion of foreign owned establishments, nor can they expect to do so in this age of alliance capitalism. Instead, the onus should be on improving the location advantages of countries and the O advantage -augmenting resources such as education and training, infrastructure, institutions, intellectual property rights protection, and other non-specific R&D support. Nonetheless, in many other ways, Krugman was also wrong -competitiveness does matter, since markets are imperfect, and resources are mobile, thereby making government intervention necessary. Its urgency is further enhanced by the fact that the current extent of involvement by governments represents a sort of prisoners dilemma, since no country is likely to back down from the current competitiveness enhancing 'war'. We would be safe in concluding that in this age of strategic trade policies and targeted industrial development, nations that rely only on market forces to determine outcomes, are not just not playing on a level playing field, but are playing on a different playing field altogether.

The evidence on globalisation and alliance capitalism would seem to point towards a role for governments in improving the efficiency of R&D activities on an international basis. It is understandable that countries duplicating R&D investments for strategic and political reasons, especially in basic research, but the failure to create international standards, in many instances, leads to considerable misallocation of resources, particularly in applied research and development. Furthermore, different countries are often, unknowingly, engaged in subsidising the same projects by transnational firms. There is clearly a growing need to address these and other issues on an international basis, as is currently been undertaken within the framework of the WTO for intellectual property rights.

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